

From: Hinojosa, Tracy@DWR <Tracy.Hinojosa@water.ca.gov>
Sent: Tuesday, June 28, 2022 6:06 PM
To: Ekdahl, Erik@Waterboards <Erik.Ekdahl@waterboards.ca.gov>
Cc: Foresman, Erin@Waterboards <Erin.Foresman@Waterboards.ca.gov>; Riddle, Diane@Waterboards <Diane.Riddle@waterboards.ca.gov>; Frazier, Scott@Waterboards <scott.frazier@waterboards.ca.gov>; Hunt, Thaddeus@Waterboards <Thaddeus.Hunt@waterboards.ca.gov>; Holland, Matthew@Waterboards <Matthew.Holland@waterboards.ca.gov>; Leahy, Tina@Waterboards <Tina.Leahy@Waterboards.ca.gov>; Heinrich, Dana@Waterboards <Dana.Heinrich@waterboards.ca.gov>; Aufdemberge, Amy L <Amy.Aufdemberge@sol.doi.gov>; Dave Mooney <Dmmooney@usbr.gov>; Leahigh, John@DWR <John.Leahigh@water.ca.gov>; Mizell, Tripp (James)@DWR <James.Mizell@water.ca.gov>; Fock, Anna@DWR <Anna.Fock@water.ca.gov>
Subject: Electronic Transmittal: Report on Hydrologic Forecasting Improvements and Operations Outlook for TUC Orders Conditions 3 & 5

EXTERNAL:

Good afternoon—

Consistent with the February 15, 2022 and April 4, 2022 Temporary Urgent Change Orders (TUCOs) granted by the State Water Resources Control Board (SWRCB) to the U.S. Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR), and in compliance with Condition 3 and Condition 5 of those Orders (respectively), DWR and Reclamation hereby submit this report and Operations Outlook.

This Operations Outlook will also be posted to DWR's website under the Hydroclimate and Water Supply tab on [DWR's Drought Preparedness web page](#).

Please contact me if you have questions.

Sincerely,

Tracy

Tracy Hinojosa
Regulatory Compliance & Reporting Branch
SWP Operations Control Office
☎ 916-574-2333 (office)
☎ 916-915-7519 (mobile)

2022 Operations Outlook (based on June projections)

Accretions / Depletions (Condition 5b.)

Values in TAF	April	May	June	July	August	September
Sacramento Valley	147	-67	-42	-189	-119	-48
Net Delta Consumptive Use	71	133	219	267	232	147

Note: May-Sep Sac Valley values are negative to represent Depletion

Deliveries (Condition 5c.&5d.)

Values in TAF	April	May	June	July	August	September	Basis of Water Right or Contractual Agreement
SWP - Feather River Service Area*	32	120	115	129	73	29	A005630, A014443, Feather River Settlement Agreements
SWP - North of Delta Contract Deliveries*	4	4	5	6	5	5	A016950, A016952, A017514A, A021443
SWP - South of Delta Contract Deliveries*	39	38	23	30	22	5	A005630, A014443, A014445A, A017512, A025435, A025511, A025988, A026058
CVP - Settlement Contractors	187.5**	47.5	47.5	75.2	47.5	47.5	This is comprised of 75% of the Exhibit A quantities listed in the Settlement Contracts. It doesn't include the small Short Form Settlement Contracts. However, the Short Form Contracts only represent approximately 1.4% of the SRSC water quantities. (**This is the number scheduled, but prior to the April 14 notice, contract diversions would be limited to 18%. No contract diversions in April from storage releases. As of May 10, Reclamation will start counting against the contract.)
CVP - Sacramento River Agricultural Water Service Contractors	7	9	10	2	7	4	Water used by these contractors is part of the 75% allocated to the Settlement Contractors (allocation to NOD Water Service Ag Contractors is 0%.)
CVP - Sacramento River Municipal and Industrial Contractors	0.997	1.285	1.948	2.357	1.726	1.419	This includes the City of Redding's M&I Settlement Contract water and the McConnel Foundation and Centerville CSD's exchange water.
CVP - American River Municipal and Industrial Contractors	0.4	0.45		1.1			PHS for SMUD. Allocation to ARD CVP M&I Contractors is zero.
CVP - Contra Costa Water District	4.246	6.613	5.936	7.300	7.250	5.600	CVP M&I estimated scheduled diversions.
CVP - North of Delta Refuges	0.420	0.900	4.100	1.381	2.147	8.937	Includes Water to be Exchanged with DWR for Gray Lodge.
CVP - Exchange Contractors	44.7	79.8	104.5	119.5	96.7	49.8	Includes water being transferred to other districts, transfers are based on consumptive use reductions.
CVP - South of Delta Agricultural Water Service Contractors	0	0	0	0	0	0	Allocation to SOD Water Service Ag Contractors is 0%.
CVP - South of Delta Municipal and Industrial Service Contractors	1,450	1,650	0	13,676	0	0	
CVP - South of Delta Refuges	7,869	14,684	6.06	5,085	10.46	47.49	Refuge Water Supply Contract: 01WC201756, 01WC201758, 01WC201754
CVP - OID & SSJID Water Right holders	49	69	80	75	63	47	1988 Operations Agreement
CVP - New Melones East Side Division	0	0	0	0	0	0	Per Eastside Division Shortage Policy, Contractors' allocation is zero.
CVP - Friant Unit	12,329	25,549		60			

* These values will be updated in early July.

Delta Flows (Condition 5b.)

Values in cfs or TAF	April	May	June	July	August	September
Delta Inflow at Freeport (cfs)	8285	5933	9041	10228	9586	7325
Net Delta Outflow Index (cfs)	7434	3765	5350	4011	3008	3027
SJR at Vernalis Flow (cfs)	941	716	706	276	276	303
CVP Export (TAF)	54	56	54	128	185	128
SWP Export (TAF)	36	32	16	19	19	18

Transfers (Condition 5e.)

Values in TAF	April	May	June	July	August	September
NOD to SOD (estimated)	N/A	N/A	N/A	32	43	22

Reservoir Inflow (Condition 5a.)

Values in TAF	April	May	June	July	August	September
Trinity	62	23	9	5	3	3
Whiskeytown	58	8	4	2	1	1
Shasta	252	175	138	127	122	122
Folsom	256	79	52	53	58	42
New Melones	74	25	23	21	21	17
Oroville	341	233	142	93	124	109

Reservoir Releases (Condition 5a.)

Values in TAF	April	May	June	July	August	September
Trinity Release to Trinity River	79	67	27	28	53	52
Carr Tunnel diversion	25	16	25	30	31	30
Whiskeytown to Clear Creek	12	12	12	9	9	9
Spring Creek Tunnel diversion	8	10	15	20	20	20
Shasta Release to Sac River	194	277	268	277	277	238
Folsom Release to American River	69	64	149	226	104	33
New Melones to Stanislaus River	27	25	17	9	9	9
Oroville	78	119	198	252	164	124

Reservoir End-of-Month Storage (Condition 5a.)

Values in TAF	April	May	June	July	August	September
Trinity	766	693	646	589	505	423
Shasta	1808	1646	1523	1382	1238	1135
Folsom	769	669	556	366	302	298
New Melones	922	831	753	690	638	611
Oroville	1917	1909	1732	1437	1316	1267
San Luis Reservoir	950	918	781	605	562	520

Monthly COA Balances (Condition 5f.)

Values in TAF	April	May	June	July	August	September
Monthly Balance	216	160	72	0	0	0

Does not include adjustment for New Melones



DEPARTMENT OF WATER RESOURCES
Division of Operations and Maintenance
3310 El Camino Avenue, Suite 300
Sacramento, California 95821



— BUREAU OF —
RECLAMATION

BUREAU OF RECLAMATION
Central Valley Operations Office
3310 El Camino Avenue, Suite 300
Sacramento, California 95821

Erik Ekdahl
State Water Resources Control Board
1001 I Street
Sacramento, California 95814

Re: Condition 3 of the February 15, 2022 Temporary Urgency Change Order and
Condition 5 of the April 4, 2022 Temporary Urgency Change Order

Dear Mr. Ekdahl:

Consistent with the February 15, 2022, Temporary Urgent Change Order (TUCO) by the State Water Resources Control Board (SWRCB) issued to the U.S. Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR), and in compliance with Condition 3 of the TUCO, DWR and Reclamation hereby submit this report by the State Water Project (SWP) and the Central Valley Project (CVP), also collectively referred to as Projects.

Condition 3 specifically requires DWR and Reclamation to identify and implement needed improvements to forecast methods to avoid significant over- or under- estimates of available water supplies and provide updates to the SWRCB on these efforts along with updates on current hydrologic and operational forecasts for the water year on a monthly basis starting in April of 2022 and continuing until the drought emergency is over.

Condition 3 also requires DWR and Reclamation to submit in writing monthly hydrologic and operational forecasts and include information on forecasted inflows; reservoir releases; water supply deliveries; reservoir storage levels; any Coordinated Operations Agreement debts; planned water transfers, forbearance agreement actions, exchanges, and other actions of this nature; and other relevant information that may be requested by the SWRCB's Executive Director to inform future drought-related decision making.

Subject: Condition 3 of the February 15, 2022 Temporary Urgency Change Order and Condition 5 of the April 4, 2022 Temporary Urgency Change Order 2

In this letter, the Projects provide updates on current hydrologic and operational forecasts for the water year, as well as information on planned water transfers, forbearance agreement actions, and exchanges. The attached table, prepared in response to Condition 5 of the latest TUCO, issued April 4, 2022, includes the information on forecasted inflows; reservoir releases; water supply deliveries; reservoir storage levels; and Coordinated Operations Agreement debts.

Forecasting Improvements

The Bulletin 120 and Water Supply Index (WSI) forecasts have wrapped up for the season. During this past forecast season, California experienced weather and climate conditions that greatly varied from month to month creating a complex hydrologic picture that would test any hydrologic forecast model. From extreme precipitation events in October and December to unprecedented dry, warm periods from January through March followed by an above average April in the Northern Sierra, this past fall, winter, and spring's extreme variability is a far departure from the historic seasonal norms upon which older forecasting techniques are based.

Fortunately, DWR was able to utilize data from more sources than ever before and leverage its partnerships with NOAA-National Weather Service and its investments in Airborne Snow Observatory (ASO) flights, satellite data, and modeling techniques in producing the forecasts this year. As the current drought worsens and California experiences a more arid climate, DWR will continue to investigate, develop, and implement forecast improvements in the coming years.

Bulletin 120 Improvements

The Snow Surveys and Water Supply Forecasting (SSWSF) team implemented new statistical models developed using machine-learning techniques for all watersheds. These models were trained on more data than ever and rigorously tested across random sets of years dating back to 1930 with a special emphasis on 2017-2021. The SSWSF team also developed a new methodology to compute the 90% and 10% exceedance forecasts based on an ensemble method using hydrology from the past 30 years, which better aligns with the current climate than older methodologies. Heading into the development season, the team is planning to incorporate 6-day forecasted precipitation into the methodology, rather than six days of median snow and precipitation. The team is currently developing machine-learning models for all Bulletin 120 watersheds, and these models will incorporate new datasets such as temperature, soil moisture, and climatic water deficit from the Basin Characterization Model.

Subject: Condition 3 of the February 15, 2022 Temporary Urgency Change Order and Condition 5 of the April 4, 2022 Temporary Urgency Change Order 3

Airborne Snow Observatory (ASO)

During the winter and spring of 2022, the Aerial Remote Sensing of Snow (ARSS) program conducted 34 Airborne Snow Observatory (ASO) flights over the Feather, Yuba, Truckee, Carson, Tuolumne, Merced, San Joaquin, Kings, and Kaweah River

basins. From January to June, DWR's contractors provided bi-weekly updates to the iSnoBal snow hydrology model; the model utilized snow data from the 34 ASO flights plus a combination of in-situ observations and weather information to provide a detailed look at the physical conditions of the snowpack. The ASO flight data from mid-February revealed that the snowpack established in the December 2021 storms was not as spatially distributed as traditional snow data estimates using snow pillows or snow courses would have suggested. In other words, the snowpack was more congregated along ridge lines and peaks, and less so in meadows, canyons, and gulches.

The data from the ASO flights conducted in February and March were factored into the Bulletin 120 forecasts as the data became available. As a result, forecast corrections to the snow parameters were made to reflect the fact that there was much less snow than was previously estimated by single point locations from the snow courses and snow sensors prior to the ASO flights. ASO data and iSnoBal model results during March, April, and May provided continuous verification that the accounting of the snowpack in both DWR and NOAA forecast procedures remained accurate and reflected either the accumulation or ablation of the snowpack as weather patterns oscillated from wet and cold to dry and warm.

During the summer and fall of 2022, the ARSS program will focus on updating or expanding the current database of snow-free baseline data necessary for successful winter ASO data collection. By updating existing baseline data, DWR can ensure that major changes to watersheds from fires, tree mortality, or land use are factored into the hydrologic models that use ASO data. And by expanding snow-free baseline coverage to other watersheds, DWR can implement this forecast improvement in more watersheds forecast in the Bulletin 120.

WRF-Hydro Physically Based Model

DWR's pilot program to develop WRF-Hydro physically based runoff forecast models in the Feather River and San Joaquin River watersheds continued in parallel with the Bulletin 120 forecasts and with the collection of ASO data in these two watersheds. The results of the WRF-Hydro models in both the Feather and San Joaquin River watersheds showed great promise as the season progressed, with WRF-Hydro Forecasts mirroring trends seen in other forecast techniques. The models used this past season were not fully calibrated and were in development as the forecast season progressed. DWR is working collaboratively with the National Center for Atmospheric Research (NCAR) and other partner agencies to evaluate the model results from this past season and identify areas to help improve model calibration.

Subject: Condition 3 of the February 15, 2022 Temporary Urgency Change Order and Condition 5 of the April 4, 2022 Temporary Urgency Change Order 4

DWR is also collaborating with the Center for Western Weather and Water Extremes (CW3E) to explore incorporating CW3E subseasonal to seasonal (S2S) weather and climate forecast products into WRF-Hydro. In the past month, DWR provided initial review and feedback on CW3E's forecast products with the goal of continuing to pursue the development and integration of these project into the WRF-Hydro model.

UC Davis Watershed Environmental Hydro-Climate Model

UC Davis is under contract with DWR to develop their Watershed Environmental HydroClimate (WEHY) hydrologic model for the Lake Shasta and Lake Oroville watersheds, and during May and June, DWR provided initial review and feedback on UC Davis' draft proof of concept report. DWR's feedback focused on near-term improvements that could be made to the model, plus comments on longer-term improvements to consider in future years under a new contract. Future meetings will focus on the near-term improvements as well as a training program for DWR staff to learn how to operate and interpret the WEHY model.

Projected Hydrology and Runoff

The DWR's Hydrology and Flood Operations Branch within the Division of Flood Management produces estimates of water year runoff, or the water supply index (WSI), for the major watersheds of the Sacramento and San Joaquin River basins. The WSI forecast is a statistically based forecast of Water Year runoff for each major river basin in the Sacramento and San Joaquin valleys (Sacramento, Feather, Yuba, American, Stanislaus, Tuolumne, Merced, and San Joaquin). The runoff forecasts are produced at the beginning of the month from December through May.

Although the final official Water Supply Index Bulletin 120 (B120) forecast was issued on May 1, 2022, the forecast provided in this submittal has been adjusted to account for observed conditions in June, and very dry conditions through September.

The Projects use the 90% exceedance forecast for the joint operations plan included in this report and the June Drought Plan addendum. The hydrologic forecast is unique to this water year and informed by precipitation, runoff, snowpack, and other antecedent hydrologic conditions, combined with the runoff associated with the antecedent conditions and the anticipated runoff resulting from precipitation forecasted to occur through September 30.

SWP and CVP Operations Forecasts

The operations forecast uses the runoff forecast as model inputs to simulate Project operations under various regulatory requirements and produce forecasted reservoir storages, releases, and flows under the same hydrologic exceedances. This operations forecast gives general guidance for annual water delivery, storage management, and

Subject: Condition 3 of the February 15, 2022 Temporary Urgency Change Order and Condition 5 of the April 4, 2022 Temporary Urgency Change Order 5

power planning purposes for this exceedance assumption. Actual hydrologic events unfold in time steps shorter than a month and are often unpredictable more than a few days to a week out. Day-to-day operations are driven by operating criteria such as those found in U.S. Army Corps of Engineers flood control manuals, SWRCB D-1641 Bay-Delta Standards, the NMFS and USFWS Biological Opinions, and the ITP for the SWP. Outputs from forecast model, as provided in this Drought Plan, represent system responses to the overlay of specific expected monthly operating criteria on each of the discrete hydrologic scenarios provided in the May 1 water supply forecasts.

The forecast assumptions utilize existing storage conditions, actual precipitation through May, forecasted runoff based on the May 1 B120 90% exceedance hydrology, projected water supply deliveries, and meeting existing flow and water quality standards, and fish and wildlife protections. The forecast includes monthly storage levels, reservoir releases, Delta export rates, and Delta outflow through September 30, 2022. DWR and Reclamation will continue to update the operations forecasts each month, and expect that with each updated operations forecast, SWP and CVP operations may change.

Planned Transfers, Forbearance Agreement Actions, Exchanges

As of June 27, 2022, nine groundwater substitution transfer proposals (six from the Feather River watershed and three from American River watershed) have been submitted to DWR's online database system Water Transfers Information Management System. In addition, two reservoir release Intent to Transfer were submitted (one from Feather River and one from American River watersheds, respectively). Currently, there are no planned transfers and forbearance agreement actions from the Sacramento River Settlement Contractors to water users south of the Delta. Transfers may still occur between various contractors north of the Delta. Table 1 below shows the estimated maximum quantity of short-term transfers in various watersheds with the method to make water available to transfer.

Table 1: Estimated Maximum Quantity of Short-Term Transfers (acre-feet before any losses) as of June 27, 2022

Method to Make Water Available for Transfer	Feather River	American River	Total
Groundwater Substitution	19,819	14,698	34,517
Cropland Idling/Shifting	0	0	0
Reservoir Release	10,000	20,000	30,000
Total	29,819	34,698	64,517

On June 27, 2022, Yuba Water Agency provided the latest forecast for a total of 75,462 acre-feet of the Yuba Accord water transfer in 2022. Table 2 below shows the estimated Lower Yuba River Accord Component water quantity to DWR and Reclamation

Subject: Condition 3 of the February 15, 2022 Temporary Urgency Change Order and Condition 5 of the April 4, 2022 Temporary Urgency Change Order 6

Participating Contractors. The total quantity will be updated periodically during the transfer year.

Table 2: Estimated Lower Yuba River Accord Component Water (acre-feet before any losses)

Estimated Lower Yuba River Accord Component Water Quantity (acre-feet before any losses)	
Component 1	13,062
Component 4	62,400
Total	75,462

Ongoing exchanges through the Consolidated Place of Use (CPOU) between the two Projects continue to be reported through the CPOU monthly reports. As authorized under the 2021-2022 CPOU order, the total quantity of transfers and exchanges will not exceed 431,780 acre-feet from July 16, 2021 through July 15, 2022.

On May 11, 2022, DWR and Reclamation submitted a Petition for Temporary Change to modify the State Water Project and Central Valley Project Authorized Place of Use through 2022-2023 CPOU request for a total amount of water to be exchanged not to exceed 393,385 acre-feet.

If you have any questions, please contact Molly White of DWR at (916) 574-2722 or Kristin White of Reclamation at (916) 979-2199.

Sincerely,

Molly White

Molly White, Manager
Water Operations Office
Division of Operations and Maintenance
Department of Water Resources

Kristin White

Kristin White, Operations Manager
Central Valley Operations Office
Bureau of Reclamation

Attachment

cc: Diane Riddle (Diane.Riddle@waterboards.ca.gov)
Scott Frazier (Scott.Frazier@waterboards.ca.gov)
Erin Foresman (Erin.Foresman@waterboards.ca.gov)
Thaddeus Hunt (Thaddeus.Hunt@waterboards.ca.gov)
Matthew Holland (Matthew.Holland@waterboards.ca.gov)
Tina Leahy (Tina.Leahy@waterboards.ca.gov)

Subject: Condition 3 of the February 15, 2022 Temporary Urgency Change Order
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7

Dana Heinrich (Dana.Heinrich@waterboards.ca.gov)

Amy Aufdemberge (Amy.Aufdemberge@sol.doi.gov)

David Mooney (Dmmooney@usbr.gov)

John Leahigh (John.Leahigh@water.ca.gov)

James Mizell (James.Mizell@water.ca.gov)